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Reference

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The title of invention	THE METHOD OF DEFORMED BILLETS MANUFACTURE FROM METALLIC CHIPS AND THE DEVICE FOR ITS IMPLEMENTATION.
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THE METHOD OF DEFORMED BILLETS MANUFACTURE FROM METALLIC CHIPS AND THE DEVICE FOR ITS IMPLEMENTATION.

MJIK C22B 7/00, 9/00

The present invention relates to metallic chips recycling, preferably, titanium alloys metallic chips. Strained billets can be used for producing consumable electrodes for obtaining secondary casting alloys, in blacksmith's work for obtaining forgings, extruded semi-finished products and the like.

The most commonly known (about 45% of the total amount of waste products of the titanium industry) and the most difficult to be recycled sort of waste products is chip scrap, the difficulty of preparation of which for recycling consists in it's great volume, contamination with emulsion, technical oil contamination, as well as foreign particles of another alloys contamination and the like. At present time only minor amount of chip scrap waste products is recycled mainly in metallurgy industry, the greater part of it is utilized with violation of environmental requirements and without deriving economic benefits.

The well-known method for producing strained billets (1), comprising cleaning of the titanium chip scrap and further briquetting by cold molding with simultaneous influence of electric current sharp pulses, which provide partial diffusion welding of individual chip scrap elements and obtaining briquettes with relative density up to 0,45 of alloy density. The disadvantage of said method is low density of chip scrap briquettes and considerable power intensity of the process.

The well-known method for producing strained billets in the form of consumable electrodes from titanium alloys (2) bulk scrap waste products, characterized in that, the waste products are stowed into the capsule with end plates (templates), which is charged into appropriate configuration container, and further axial force is applied to the end plates with simultaneous electric current passing through them and the layer of waste products to provide diffusion welding in bulk

scrap waste products contact zone among them. This process is most similar to the method claimed.

The prior art has the following disadvantages: manufacturing the capsule of the same name with waste products titanium alloy, considerable power intensity of the process, and low density of obtained billets, which does not exceed 60% of base metal density.

The well-known device for pressing billets for consumable electrodes (3), preferably from chip scrap and shear cuttings, comprising container mounted on the basis, a mould placed in it, principal press-washer fixed on a compression ram and an autonomous press-washer. This device is deficient in that, under conditions of hot deformation of titanium chip scrap briquettes, which are placed into shielded arc (cyn. gas protection) capsule, its covering corrugates because of friction between the surfaces of the mould and capsule.

It is an object of the invention to improve titanium chip scrap waste products strained billets due to increase in density and exclusion of capsule material corrugating with simultaneous withdrawal from capsule manufacturing process expensive materials and power intensity reduction of the process.

The essence of the method is characterized in that, after crushing and cleaning the chip scrap is pressed to form cylindrical shape briquettes, which are placed into the capsule with further sealing-in thereof, heating, loading, into the press rigging mould, hot deformation in axial direction and cooling. The difference consists in that, the hot deformation in axial direction is carried out by dynamic impingement force having frequency and efforts of blows, sufficient to provide relative density of billets not less than 0,95, and at that deformation effort is applied all over the surface of upper or lower (bottom) butt-end of the capsule, and from the opposite butt-end of the capsule – over the surface the diameter of which is less than capsule diameter by two thicknesses of capsule cowling size, at that the mould and press rigging elements are heated to the temperature not less than 0,2 of capsule heating temperature.

In particular cases of process realization the difference consists in that, deformation effort is applied simultaneously from the direction of upper and lower

(bottom) butt-ends of the capsule over the surfaces, which diameters are less than capsule diameter by two thicknesses of capsule cowling size, the cold molding of chip scrap briquettes is carried out to provide relative density not less than 0,6, hot deformation (depression) is carried out up to capsule deformation degree not less than 35%; and cowling and capsule covers are manufactured of low-carbon steel, which is removed mechanically after capsule cooling.

Impingement deformation allows to diminish the time the instrument contacts with the billet and to improve the temperature condition of the process, and deformation up to density of not less than 0,95 gives the opportunity of further hot deformation of the billets without special protection against oxidation to obtain commodity output in the form of bars, plates, tubes and different configuration forgings.

The application of deformation effort all over the surface of upper or lower (bottom) butt-end of the capsule is made for exclusion of possible outflow of metal through clearance between press-washer and mould, and from the opposite butt-end over the limited surface is caused by necessity to provide free chamber for receiving cowling material.

Heating of the extrusion toolage to the temperature of 0,2 and above capsule heating temperature excludes excessive cooling of the surface layers of the billet.

The deformation from the direction of upper and lower (bottom) butt-ends of the capsule over the limited surfaces provides cowling metal outflow in the opposite directions and diminishes the contact friction between the capsule and the mould.

The cold molding of chip scrap briquettes up to relative density of not less than 0,6 allows to diminish corrugating susceptibility of the capsule, and depression with deformation degree not less than 35% provides the obtaining the billet with relative density of 0,95 and more.

The use of low-carbon steel for manufacture of the capsule diminishes its cost and simplifies cowling removing from the titanium base of the billet.

The essence of the device for manufacture of strained billets is characterized in that it comprises container mounted on the basis, a mould placed in it, a compression

ram with principal press-washer fixed on it and an autonomous press-washer. The distinguishing features are characterized in that, the autonomous press-washer is placed on the basis, and the work space of the principal or the autonomous press-washer has the diameter which is less than internal diameter of the mould by two thicknesses of capsule cowling size and the height which is not less than capsule deformation degree in axial direction.

Allocation of the autonomous press-washer on the basis and geometrics of the work spaces of one or both press-washers form chambers for receiving cowling metal excluding the possibility of forming of corrugations on the billet surface, and manufacture of the work space height 1,2-1,5 times more than capsule depression degree eliminates probability of press tools struting, which can lead to tool breakage.

The example of implementation of the process. Metal chip scrap of titanium alloy BT5 grade was crushed into particles with particle size of (5 - 10) - (5 - 20) mm, contaminants and foreign particles were removed by rinsing in solution, comprising 30 - 35 g/l of soda ash and 15 - 20 g/l of trisodium phosphate at the temperature of 60 - 80°C, further it was rinsed in water, dried and was subjected to magnetic separation. Prepared in this way chip scrap was pressed to form cylindrical shape briquettes having the diameter of 150 mm and of 100 mm height with relative density of 0,6, which were placed into the capsule manufactured of low-carbon sheet steel CT3 grade. Wall thickness of capsule cowling and butt-end covers was 2,0 mm, capsule height was 300 mm (without taking thickness of covers into consideration).

After sealing-in by means of cover welding the capsule was heated in gas-furnace to the temperature of 1080°C for 1,5 - 2 hours, and was kept at said temperature for 1 hour for temperature equalization through capsule volume. The extrusion toolage was preheated to the temperature of 250 - 270°C, further the capsule was placed into it, the surface temperature of the capsule before deformation was 950 - 980°C. The work space of the autonomous press-washer was 150 mm in diameter and 130 mm in height (1,24 of depression degree). The diameter of the work space of the principal (upper) press-washer was 155 mm. The deformation was carried out by means of steam-air hammer with falling parts mass of 700 kg. and strain rate in the

thump point of 5-6 m/sec. Two thumps from soft to hard were carried out with strain rate of 35 %.

After extraction of the billet from the mould it was slowly cooled (with furnace), then steel cowling was removed by turning on a lathe.

After the steel cowling removal there were no corrugations on the billet surface since outflow of cowling material into the chamber formed in the bottom part of the mould between its wall and the autonomous press-washer had taken place. The billet relative density amounted 0,96.

Further the billet was forged in radial direction up to 100 mm in diameter. The billet relative density after radial forging increased up to 0,97. There were four capsules manufactured in all, said capsules were jumped with different rates of deformation and number of hammer blows. The obtained chip scrap billets of titanium alloy BT5 grade after hot deformation and radial forging were subjected to mechanical test, the results of said mechanical test and conditions thereof are given in Table.

The device will now be described in greater detail with the accompanying drawings, in which Fig. 1 and Fig. 2 show the extrusion toolage in section with chambers for receiving cowling metal in bottom, and in bottom and upper parts of the mould.

The device comprises container 2 mounted on the basis 1, a mould 3, a compression ram 4 with principal press-washer 5 fixed on it and an autonomous press-washer 6 mounted on the basis 1. The work space of press-washers 5 and/or 6 is manufactured in such a way that in bottom and/or upper parts of the mould 3 the chambers 7 for receiving cowling material 8 during hot deformation of the capsule charged with chip scrap briquettes 9 are formed.

The analysis of the Table data shows, that stress-strain properties of the strained titanium chip scrap billets are up to standard of secondary casting alloy.

Table

Billets №№	Rate of deformation, %	Number of hammer blows	Relative density of strained billets	σ_B, MPa	δ, %	KCU, kJ/cm^2
1	35	2	0,95/0,97*)	870/910	1,0/1,2	35/36
2	36	3	0.96/0,98	900/970	1,2/1,5	35/38
3	37	2	0,97/0,98	920/990	1,3/1,8	36/40
4	38	3	0,98/0,99	980/1020	1,8/2,2	40/42

*)

- stress-strain properties of billets after hot deformation (depression) are given in numerator;
- stress-strain properties of billets after hot deformation and radial forging are given in denominator.

(56) Bibliography (Source information):

1. Abramova K.B. and others. Briquetting of titanium chip scrap under the influence of electric current sharp pulses., "Tsvetnye metally", 1998, №12, p. 70 - 74.

2. Patent RF №2114925, C22B 9/20, H05B 7/06, 1998.

3. Patent RF №2148665, C22B 9/20, H05B 7/07, 2000.

CLAIMS

1. The method of strained billets manufacture from metallic chips, preferably, from titanium alloys metallic chips, comprising crushing and cleaning of chip scrap, cold molding of cylindrical shape chip scrap briquettes, placing said briquettes into the capsule, sealing-in the capsule with butt-end covers with further heating thereof, loading into the mould of press rigging, hot deformation in axial direction and cooling, *characterized in that* the hot deformation is carried out by dynamic impingement force having frequency and efforts of blows, sufficient to provide relative density of billets not less than 0,95, and at that deformation effort is applied all over the surface of upper or lower (bottom) butt-end of the capsule, and from the opposite butt-end of the capsule – over the surface the diameter of which is less than capsule diameter by two thicknesses of capsule cowling size, at that the mould and press rigging elements are heated to the temperature not less than 0,2 of capsule heating temperature.

2. The process in accordance with Claim 1, *characterized in that* the deformation effort is applied from the direction of upper and lower (bottom) butt-ends of the capsule over the surfaces the diameters of which are less than capsule diameter by two thicknesses of capsule cowling size.

3. The process in accordance with Claim 1, *characterized in that* the cold molding of chip scrap briquettes is carried out up to relative density of not less than 0,6.

4. The process in accordance with Claim 1, *characterized in that* the hot deformation in axial direction is carried out up to rate of capsule deformation of not less than 35%.

5. The process in accordance with Claim 1, *characterized in that* the cowling and capsule covers are manufactured from low-carbon steel, and they are removed mechanically after cooling, for example, by turning.

6. The device for manufacture of strained billets from metallic chip scrap, preferably, from titanium alloys metallic chips, said device comprises container mounted on the basis, a mould placed in it, a compression ram with principal press-washer fixed on it and an autonomous press-washer, *characterized in that* the autonomous press-washer is placed on the basis, and the diameter and height of the work space of the principal or the autonomous press-washer is correspondingly less than internal diameter of the mould by two thicknesses of capsule cowling size and is greater than the rate of capsule deformation in axial direction.

7. The device in accordance with Claim 6, *characterized in that* the principal and autonomous press-washers have work space the diameters of which are less than internal diameter of the mould by two thicknesses of capsule cowling size and the height of both work spaces in total is greater than the rate of capsule deformation in axial direction.

8. The device in accordance with Claim 6 and 7, *characterized in that* the height of the work space of the principal and/or the autonomous press-washers is 1,2 - 1,5 of the rate of capsule deformation in axial direction.

THE METHOD OF STRAINED BILLETS MANUFACTURE FROM METALLIC CHIPS AND THE DEVICE FOR ITS IMPLEMENTATION.

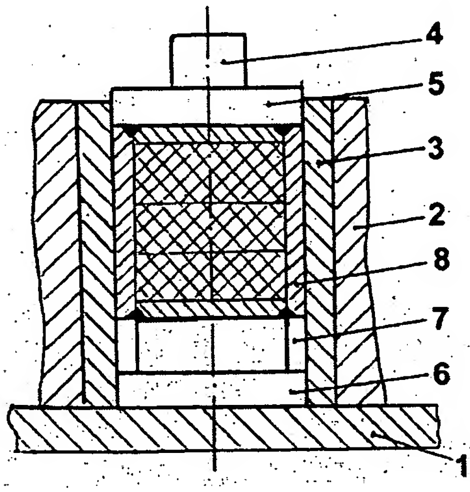

Fig. 1.

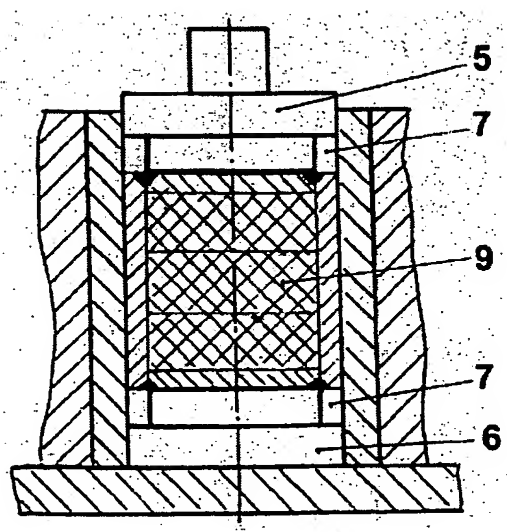

Fig. 2.

THE ABSTRACT

The invention "The method of strained billets manufacture from metallic chips and the device for its implementation."

The present invention relates to metallic chips recycling.

The method is characterized in that after crushing and cleaning the chip scrap is pressed to obtain briquettes, said briquettes are placed into a steel capsule, said capsule is heated, placed into a press rigging, and strained, said deformation is carried out by impingement attack to provide relative density of not less than 0,95, and at that press rigging is heated to the temperature of not less than 0,2 of capsule heating temperature, the deformation effort is applied all over the surface of one of butt-ends of the capsule, and from the opposite butt-end of the capsule – over the surface the diameter of which is less than capsule diameter by two thicknesses of capsule cowling size.

The device comprises a basis, a container, a mould, a compression ram, a principal press-washer and an autonomous press-washer, the diameter and height of the work space of one or both press-washers are correspondingly less than internal diameter of the mould and are greater than the rate of capsule deformation in axial direction.

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